

LETTER REPORT

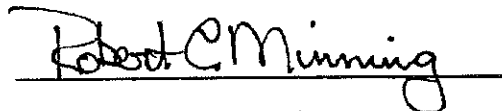
On comments prepared by the United States Environmental Protection Agency dated July 18, 2013, and supplemented in an electronic message dated September 3, 2013, regarding the "**Technical Response**" jointly submitted by R. C. Minning and Associates, Inc. and Mundell & Associates, Inc. on AMMH's behalf dated April 18, 2013.

Prepared for:

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October 17, 2013

Prepared by:

A handwritten signature in black ink that reads "Robert C. Minning". The signature is written in a cursive style and is positioned above a horizontal line.

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LETTER REPORT

In response to a request by Aimco Michigan Meadows Holdings ("AMMH"), R.C. Minning & Associates ("Minning") reviewed comments prepared by the United States Environmental Protection Agency ("EPA" or the "Agency") dated July 18, 2013, and supplemented in an electronic message dated September 3, 2013, (together "EPA 2013 Comments"), regarding the "Technical Response" jointly submitted by Minning and Mundell & Associates ("MUNDELL") on AMMH's behalf in April 2013 ("*Technical Response*").^{1/} AMMH also requested that Minning review an electronic message authored by EPA's On Scene Coordinator, Shelly Lam, dated September 4, 2013, which attached soil gas data from samples collected by EPA's contractor in January 2013 and groundwater data from samples collected in June 2013. These documents relate to the AMMH's and EPA's efforts to determine the source of contamination detected in residential drinking wells within the West Vermont Drinking Water Contamination Site (the "Residential Area") in Speedway, Indiana, and allegations that the source of that contamination is a drycleaner release (and the subsequent remediation thereof) at the former Michigan Meadows Apartments ^{2/} and Michigan Plaza properties (collectively, the "Michigan Plaza Site") located to the east and northeast of the Residential Area.

Following a brief summary of the investigations conducted at the Michigan Plaza Site and the Residential Area, as well as at the neighboring Genuine Parts and Allison Transmission Properties, this letter report addresses (1) the multiple instances that EPA failed to take into account important data and resulting inaccuracies in the EPA 2013 Comments and (2) the significance of the soil gas and groundwater data provided to AMMH by EPA in early September.

I. BACKGROUND

A. The Michigan Plaza Site

Investigations at the Michigan Plaza Site began in 2001 when AMMH went to sell the Michigan Plaza Site and it was discovered that the groundwater at the Site had been impacted by what turned out to be chemical releases at the upgradient Genuine Parts located to the north of the Michigan Apartments property and leaking sewers near a drycleaner that operated on the Michigan Plaza property prior to AMMH's ownership. After extensive subsurface investigations, in 2007, AMMH enrolled the Michigan Plaza Site in the Voluntary Remediation

^{1/} See Minning & MUNDELL, "Technical Response to January 30, 2013 U.S. EPA 'Technical Memorandum: Analytical and Hydrogeological Evaluation, West Vermont Street Site, Speedway, Marion County, Indiana' prepared for USEPA by Weston Solutions, Inc., West Vermont Drinking Water Contamination Site, Speedway, Indiana (April 18, 2013).

^{2/} The Michigan Meadows Apartments are now known as the Maple Creek Village Apartments but we use the Michigan Meadows name for convenience.

Program (“VRP”) administered by the Indiana Department of Environmental Management (“IDEM”) to address contamination arising from the drycleaner operation. ^{3/}

Investigations of the Michigan Plaza Site have resulted in the delineation of three on-site chemical source areas (Source Areas A, B, and C, depicted on Figure 3 of the *Technical Response*) in the vicinity of the drycleaner operation and a leaky sewer line that runs through both the Michigan Meadow Apartments and Michigan Plaza properties. Groundwater data from these investigations have repeatedly indicated that groundwater flow from the Source Areas is to the south-southeast. ^{4/}

Pursuant to the VRP, AMMH’s contractor MUNDELL conducted three remediation events: in August 2007, December 2009, and July 2013, respectively, consisting of the injection of an anaerobic bioremediation compound, CAP18[®] into the soil and groundwater at the three Source Areas. The results to date have demonstrated the effectiveness of AMMH’s remediation in reducing the volume and concentrations of the primary contaminant perchloroethylene (“PCE”). ^{5/} Coincident with the decrease in PCE has been an increase in cis-1,2-dichloroethene (“cis-1,2-DCE”) and vinyl chloride (“VC”) which are the daughter products associated with the reductive dechlorination process taking place in the Source Areas. These compounds are expected to undergo continued conversion and reduction in concentration over time.

On September 19, 2013, AMMH submitted a Remediation Work Plan (“RWP”) to IDEM setting forth AMMH’s plan for future remediation of the Michigan Plaza Site. IDEM is currently reviewing the RWP.

B. Genuine Parts Company Site

The Genuine Parts Company property is located immediately north and upgradient of the former Michigan Meadows Apartments property. Activities at the Genuine Parts site have resulted in the release of trichloroethylene (“TCE”), cis-1,2-DCE and VC.^{6/} The property owners have entered into a VRP with IDEM and have implemented limited on-site remediation operations. However, cis-1,2-DCE and VC continue to migrate from the Genuine property with the groundwater flow system to the south-southwest, beneath Little Eagle Creek, with the southerly component traveling onto and through the Michigan Plaza Site. ^{7/}

^{3/} These investigations are summarized in the Remediation Work Plan AMMH submitted to IDEM on September 19, 2013 (“RWP”).

^{4/} *Technical Response* at 2-6.

^{5/} RWP at Table 3 (groundwater), Tables 4A, 4 B, and 4C & Appendix L.

^{6/} *Id.* at 50.

^{7/} *Id.* at 56, 58-59.

C. Allison Transmission Site

West-northwest of the Michigan Plaza Site on the west side of Holt Road is the Allison Transmission Site ("ATS") which includes six plants. Historically there have been documented releases of polychlorinated biphenyls ("PCB"), transmission fluid, and volatile organic compounds ("VOCs") including PCE and its degradation products at multiple locations on the ATS.^{8/} Currently, the ATS is undergoing corrective action pursuant to the Resource Conservation and Recovery Act ("RCRA"). That work includes operation of a groundwater recovery system northwest of the Residential Area. Groundwater flow direction at the ATS is locally affected by the recovery system but in general flows to the south-southeast towards Eagle Creek.^{9/}

D. The Residential Area

Analysis of groundwater samples collected from private wells in the Residential Area by the Marion County Health Department revealed the presence of VC in two wells at concentrations exceeding the EPA Maximum Contaminant Level of 2 micrograms per liter (ug/L).^{10/} Follow-up sampling and analysis by EPA confirmed the presence of VC in private wells in the Residential Area. Subsequently, EPA contracted with Weston Solutions, Inc. ("Weston") to conduct analytical and hydrogeological investigations to determine the source(s) of the VC contamination. Those investigations were presented in two Technical Memoranda ("TM") dated March 27, 2011 and January 31, 2013, respectively.^{11/} Weston concludes in the 2011 TM, among other findings, that (1) Michigan Plaza was "*cross-gradient*" from the VC contamination at the Residential Area; (2) injection of "*several thousand gallons of water*" during the CAP18[®] injections "*may have caused cross-gradient flow towards the residential neighborhood;*" and (3) "*contamination of the Residential Site likely is attributable to historic releases of chlorinated solvents to groundwater from the Genuine Auto Parts Site. The Allison Transmission Site may also have contributed chlorinated solvents to the residential Site prior to the control of groundwater through the remedial system.*"^{12/}

In November and December 2011, EPA conducted a subsurface investigation in areas between the Residential Area and the Allison, Genuine Parts, and Michigan Plaza Sites. Weston

^{8/} Weston Solutions, Inc. (Vernon Hills, Illinois), "Technical Memorandum - Analytical and Hydrogeological Evaluation, West Vermont Street Contamination Site, Speedway, Marion County, Indiana," dated March 27, 2011 ("2011 TM") at 2.

^{9/} 2011 TM at Figures 10A and 10B.

^{10/} *Id.* at 2

^{11/} Weston Solutions, Inc. (Okemos, Michigan), "Technical Memorandum -- Analytical and Hydrogeological Evaluation, West Vermont Street Site, Speedway, Marion County, Indiana," dated January 30, 2013 ("2013 TM"); 2011 TM.

^{12/} 2011 TM at 23-24.

presented the results of this investigation in the 2013 TM, and there concludes: (1) that “[h]istorically, DCE and VC migrated from Genuine Parts to the south-southwest,” near the Residential Area; (2) that Michigan Plaza was now considered “upgradient” of the Residential Area; and (3) AMMH’s CAP 18® injections had somehow altered groundwater flow and directed VC towards the Residential Area. 13/

Following issuance of the 2013 TMM, AMMH commissioned MUNDELL and Minning to review EPA’s conclusions, which culminated in a meeting with EPA on March 20, 2013, and submission of the *Technical Response* a month later. In brief, the *Technical Response* demonstrates that:

- (1) all available data and every analysis performed to date show that Source Areas A, B and C associated with the Michigan Plaza Site are side or cross gradient with respect to the Residential Area, and that no groundwater flow lines from Source Areas A, B or C pass through the Residential Area or even come close; 14/
- (2) the Weston hypothesis that the injections of CAP 18® resulted in “increased hydraulic head” and caused “a change in groundwater flow direction” is not supported by the data; 15/
- (3) increases in detection of VC at monitoring well 170-D cannot be attributed to CAP 18® injections because there is no groundwater flow between the injection locations and that well and VC produced by the reductive dechlorination process could not have reached monitoring well 170-D in the time hypothesized by EPA; 16/ and
- (4) a continuous upper glacial till surface at the Michigan Plaza Site acts as a boundary to the vertical extent of chlorinated solvent impacts near the Source Areas, but does not extend north to the Genuine Parts Site. 17/

EPA responded to the *Technical Response* with the EPA 2013 Comments, which are addressed below.

II. POTENTIOMETRIC SURFACE AND DIRECTION OF FLOW

EPA alleges that AMMH has failed to delineate the contamination at the Michigan Plaza Site and failed to consider various factors in assessing groundwater flow from the three Michigan

13/ 2013 TM at 2, 8, 28.

14/ *Technical Response* at 2-6

15/ *Id.* at 7-10

16/ *Id.* at 10-13

17/ *Id.* at 13-14

Plaza Source Areas (Source Areas A, B and C). ^{18/} We address these issues separately in the sections that follow.

A. Source Area Delineation

EPA Comment. EPA states that “[t]he Source Areas (referenced in various reports as Source Areas A, B, and C) have not been fully delineated.”^{19/} EPA bases this assertion on three main arguments. First, the Agency notes that AMMH recently expanded Source Area B following the collection of additional data in the area. ^{20/} Second, EPA relies on two letters from IDEM – a letter dated June 22, 2011 alleging that AMMH had not delineated the Michigan Plaza Site and a letter dated November 1, 2012 stating that “the interpretation of the plume’s nature and extent is unsupported.” ^{21/} Third, EPA maintains that AMMH has “assumed” that a sewer line belonging to Floral Park Cemetery that is aligned east to west along the northern edge of the Floral Park parking area is not a preferential pathway and has not investigated it “despite being less than 80 feet down-gradient of Source Area A and 200 feet up-gradient of the nearest contaminated residential well.”^{22/}

Response. Importantly, EPA neither cites to a single data point nor to a single plume map of the Michigan Plaza Site to support its assertion that the Michigan Plaza Site has not been adequately delineated. As to EPA’s first argument, MUNDELL’s adjustments to the size of Source Area B were truly minor. Specifically, rather than defining Source Area B as ending near MMW-8S, MUNDELL expanded the Source Area approximately 50 feet to the west to include the area around SB-05.^{23/} MUNDELL did not extend the area further because the results in SB-06 show no contamination. ^{24/} MUNDELL made a similar adjustment to Source Area A, extending it approximately 75 feet to the north along the west side of the Plaza complex to reflect results obtained at Geoprobe boring GP-31.^{25/} Minor adjustments to source areas are not unusual. Moreover, these small changes did not result in any changes to potentiometric maps, which continue to show groundwater flow from the Source Areas to the south and southeast. Far from showing that the Source Areas have not been delineated, these minor adjustments were made in acknowledgment of the fact that the Source Areas had been fully delineated.

The IDEM letters referenced above also do not support EPA’s contention that the Source Areas have not been fully delineated. IDEM authored the June 22, 2011 letter more than two years ago and AMMH’s and EPA’s Source Areas delineation efforts since then have rendered

^{18/} EPA 2013 Comments at 2-5.

^{19/} *Id.* at 2.

^{20/} *Id.*

^{21/} *Id.* at 2.

^{22/} *Id.* at 2-3

^{23/} Compare *Technical Response* at Figure 3 to MUNDELL, *Technical Response to the General Notice of Potential Liability Letter, Michigan Plaza Property, April 27, 2011* at Figure 14a. .

^{24/} *Id.*

^{25/} *Id.*

the June 22, 2011 letter out of date. Since June 22, 2011, AMMH has undertaken several additional investigations to further delineate the Source Areas, including the installation of, and sampling from, 15 additional groundwater monitoring wells (six of which were nested pairs) and 40 additional soil borings between August 2011 and March 2013. Likewise, EPA undertook its own investigation on December 6 and 7, 2011, which consisted of gauging 152 monitoring wells and sampling 66 monitoring wells. AMMH discussed the resulting additional data with the EPA in two extended in-person meetings (on May 15, 2012 and March 21, 2013) and addressed the data at length in the *Technical Response*. Under these circumstances, reliance on IDEM's 2011 assessment of the situation to conclude that the Michigan Plaza Site is not delineated is simply not justifiable.

IDEM's November 1, 2012 letter also does not support EPA's contention that the Source Areas are not fully delineated. The language quoted by EPA in support of its position must be read in context. In the November 1st letter, IDEM first lists a number of corrections it wants MUNDELL to make to particular figures and then states: "*Furthermore, the maps should be revised to accurately depict the supporting analytical data. **Without this data**, the interpretation of the plume's nature and extent is unsupported.*" See Letter from IDEM (November 2, 2012) (emphasis added). Quoted in context, it is clear that IDEM was referring to specific data referenced on particular figures, and was not drawing a general conclusion regarding delineation of the site. Moreover, MUNDELL responded to IDEM in a letter dated December 21, 2012, and addressed IDEM's specific comment. IDEM was sufficiently satisfied with the additional information that it authorized AMMH to proceed with additional injections of CAP18® in each Source Area under the state voluntary cleanup program. See Letter from C. Anderson (IDEM) to P. Cappel (June 3, 2013).

EPA's third argument is equally unavailing. MUNDELL encountered the sewer line along the northern edge of the Floral Park Cemetery parking lot at a depth of only 3 feet below ground level (bgl). The depth to the water table in that area based on numerous measurements made in nearby monitor wells (e.g., wells MMW-P-03, MMW-P-11S and MMW-P-13S) is in the range of 15 – 20 feet bgl. ^{26/} Therefore, site data and measurements show that both the sewer line and associated backfill are 12 to 17 feet above the water table, i.e., in the unsaturated zone and not in the groundwater flow system. As such, there is no potential for a preferential pathway to be associated with the sewer line.

B. Effects Of Surface Water and Residential Pumping on Groundwater Flow

EPA Comment. EPA asserts that "*no consideration of the changes in groundwater flow gradients due to changes in the stream flow conditions [in 2007 and 2008] have been presented*

^{26/} See MUNDELL, Second Quarter 2013 Monitoring Report (July 31, 2013) ("MUNDELL 2Q 2013 Report") at Table 1

in the Technical Response or other reports for Michigan Plaza."^{27/} Similarly, the Agency contends that AMMH failed to consider that pumping from residential drinking water wells and two Allison Transmission remediation systems could have pulled groundwater contamination to the west, across Holt Road and into the Residential Area.^{28/}

Response. EPA's assertion that AMMH has not considered impacts to groundwater flow based on stream flow conditions and other identified "hydraulic stresses" is not correct. MUNDELL's potentiometric maps for June 14, 2007, September 19, 2007 and December 12-14, 2007 (Figures 18, 19 and 20 in the *Technical Response*) and for March 21, 2008 and June 2, 2008 (Figures 21 and 22 in the *Technical Response*) together with a potentiometric surface map for November 19 - 20, 2008 (submitted to IDEM in MUNDELL's Quarterly Monitoring Report dated October 22, 2009) are based on actual groundwater elevation data collected during the precise time periods referenced by EPA. The extent to which stream flow conditions have impacted hydraulic gradients and groundwater flow direction is reflected in the site data. In other words, if low stream flow conditions had impacted groundwater flow, that impact would be seen when groundwater levels were measured, converted to elevations, and incorporated into potentiometric surface maps. Accordingly, there is no need to hypothesize as to the impact of stream conditions on groundwater flow as that impact has been actually measured and reported in the quarterly monitoring reports that support the potentiometric surface maps provided in the *Technical Response*.

The same point applies to the other hydraulic stresses mentioned by EPA – if and to the extent they impact the groundwater flow system, then they are reflected in groundwater data collected throughout the relevant time period.

C. Groundwater Flow Direction

EPA Comment. In the EPA 2013 Comments, EPA presents Figures 5a and 5b in support of potentiometric surface lines trending northwest to southeast and groundwater flow to the west-southwest. EPA further opines that the west-southwest flow direction may extend into the groundwater under Michigan Plaza, but that "*due to an insufficient number of monitoring wells in this area, one cannot determine how far to the southeast this west-southwest trending groundwater occurs.*" ^{29/}

Response. There is no support for EPA's conclusion that groundwater flow is to the west-southwest or that there are an insufficient number of monitoring wells in the area in question. First, ARCADIS (Allison's consultant) prepared Figure 5a based on October 2007 data and Figure 5b based on April 2009 data. EPA is correct that these figures show groundwater flow to the west-southwest between the Allison site and the Residential Area.

^{27/} EPA 2013 Comments at 3.

^{28/} *Id.* at 4.

^{29/} EPA 2013 Comments at 4.

However, the potentiometric contours lines displayed on the figures stop just east of North Rybolt Avenue, and thus do not provide any information on groundwater flow direction from the Michigan Plaza Source Areas. Importantly, EPA's own updated figures (October 2010 and December 2011) continue to show the same potentiometric surface contour lines between the Allison site and the Residential Area, but also confirm a change in orientation of the contour lines in the vicinity of Michigan Plaza Site, with the lines in those areas becoming east-west and the corresponding groundwater flow direction *to the south*. ^{30/} This change in groundwater flow direction is supported by multiple figures included in the *Technical Response*. In particular, Figure 11, which ARCADIS also prepared, reflects October 2010 data and shows the same potentiometric surface orientation in the area southeast of the Allison facility as in Figures 5a and 5b cited by EPA above. However, east of the Allison facility, in the area questioned by EPA, the change in the orientation of the potentiometric surface elevation contours in the vicinity of Michigan Plaza to east-west is readily apparent. There is no west-southwest groundwater flow direction at any of the Michigan Plaza Source Areas. This same change in orientation is evident in EPA's own potentiometric surface maps, which are presented as Figures 1, 2, 4 and 5 of the *Technical Response*. Figures 1 and 2 in the *Technical Response* are EPA's Figures 10a and 10b from the 2011 TM, and are based on the gauging of 131 wells. Figures 4 and 5 in the *Technical Response* are EPA's Figures 11 and 12 from the 2013 TM, and use the data from 152 wells.

These same figures – prepared by EPA's contractor and relied upon by EPA – show that there are more than a sufficient number of monitoring wells in the area around the West Vermont Drinking Water Contamination Site and the Michigan Plaza Source Areas to accurately define the potentiometric surface and direction of groundwater flow. Indeed, this is precisely the area upon which EPA's own investigation focused. The 2011 TM identified a lack of potentiometric surface data “...to the west of the Genuine Auto Parts, Michigan Meadows Apartments, and Michigan Plaza properties, as well as within the Residential Area.....This data gap can be addressed through the installation and sampling of monitoring wells to depths similar to the residential water well levels.” ^{31/} Subsequently, EPA installed thirteen monitoring wells in the “data gap” area and Weston concluded in its 2013 TM that it had attempted to fill those data gaps during its investigation. ^{32/} AMMH also installed eight additional monitoring wells in the same area. These additional wells, together with the wells that existed prior to EPA's investigation, provide sufficient data upon which reliable conclusions can be drawn regarding groundwater flow direction between the Source Areas and the Residential Area.

EPA Comment. In its July 2013 response, EPA cites a number of triplicates (*i.e.*, water levels analyzed from limited ‘three well’ sets only), the triangulation of which results in flow directions from 180 to 351 degrees. AMMH's request for the backup data resulted in an

^{30/} 2011 TM at Figures 10a and 10b; 2013 TM at Figures 11 and 12.

^{31/} 2011 TM at 21.

^{32/} 2013 TM at 28

electronic message dated September 13, 2013, from Shelly Lam to Pete Cappel, in which EPA presented two sets of five triplicates based on the Michigan Plaza December 2007 and August 2009 quarterly monitoring data sets. The individual flow directions from the triplicates ranged from 190° to 331° for December 2007 and 240° to 356.3° for August 2009, and prompted EPA to conclude that "...these calculations show a west-southwestward component to the groundwater flow gradient." ^{33/}

Response. While the use of triangulation, *i.e.*, using water level elevations in three wells to determine direction of groundwater flow, is a recognized practice, full consideration also must be given to the overall accuracy of the elevations, the general hydrogeologic environment, and, most importantly, *all* valid, available data. Selective use of potentiometric surface elevations from isolated triplicates can produce a theoretically 'locally' correct result, but triangulation is generally used in those cases where there are only three data points (wells). In studies where there are multiple data points (wells) available, all valid data points should be considered in determining flow direction, and the use of well-known computer programs (*e.g.*, SURFER) for analyzing these larger data sets is standard practice. This is clear from a multitude of recognized authorities. For example, C.W. Fetter's 1994 textbook, *Applied Hydrogeology*, upon which EPA relies for a description of the triangulation method, states: "*On some occasions there may be too few wells in an area to make a full map of the water table or the potentiometric surface. For example, a waste disposal site may have only three or four monitoring wells around it.*" ^{34/} The implication is clear that a "full map" for an area should be based on more than three wells. Another textbook "*A Manual of Field Hydrogeology*," discusses hydrogeologic mapping and contouring: "*At the very least, three points are needed to define a plane. However, it is desirable to use even more than three points. Using only three points to define groundwater flow directions is risky, as described in this chapter.*" ^{35/} These references show that, far from clarifying groundwater flow, the use of only three data points, when additional data are available, is discouraged.

One of the reasons that using a limited data set is "risky" is that it accentuates the localized impact of one anomalous data point. Four of the five triplicates used by EPA to calculate flow directions for August 5, 2009 (*Technical Response* at Figure 25), utilize the water level elevation from MMW-P-06 (695.91 feet above mean sea level (amsl)), which appears anomalously low considering the water level elevations at four surrounding data points (696.99 feet amsl at MMW-P-01, 696.96 feet amsl at MMW-P-05, 696.84 feet amsl at MMW-P-02, and 696.90 feet amsl at MMW-P-04) and the water level elevations for the same 5 monitoring wells

^{33/} S. Lam, Electronic Mail to P. Cappel (Sept. 13, 2013).

^{34/} Fetter, C.W., *Applied Hydrogeology*, Upper Saddle River, N.J., Prentice Hall (1994), at 124.

^{35/} Sanders, L, *A Manual of Field Hydrogeology*, Upper Saddle River, N.J., Prentice Hall (1998) at 312.

from the preceding June 15, 2009 and subsequent November 2, 2009 quarterly monitoring data sets.^{36/} Sanders (1998) discusses such a situation:

Look for 'bull's-eyes,' multiple contours drawn about a single point, showing that the value of that point is much higher or much lower than that of surrounding points. Bull's-eyes may indicate a true, unusually high or low point in a water surface, such as could be caused by a pumping or injection well. Alternatively, they may simply indicate a bad data point (Fig. 10.6). These points should be examined carefully to determine if the data are real or spurious.^{37/}

Using the same SMARTe.org web site spread sheet analysis employed by EPA (which allows for entry of up to fifteen data points, twelve more than EPA used in its calculations) but excluding the anomalous MMW-P-06 results in a flow direction of 146.1°, rather than flow directions calculated by EPA (ranging from 240° to 356.3°). When all 8 monitoring well locations and water level elevations used in EPA's triplicates are entered (including the anomalous MMW-P-06 data) into the spreadsheet together with the data from MMW-C-01, the resulting groundwater flow direction is 192.5° which is essentially in a southerly direction.

EPA also presents a December 2007 data set incorporating eleven wells. Here again, when all of the locations and water level elevations are entered into the same spread sheet, the flow direction is 188.6° (again, a southerly direction) rather than the 190° - 331° range for the 5 individual triplicates.

Finally, EPA's new reliance on triangulation of limited data seems to repudiate the Agency's own work. EPA and its contractor Weston previously claimed that they needed more data to understand groundwater flow. In 2011 TM, Weston concluded: "*The installation of monitoring wells up-gradient, down-gradient, and cross-gradient, relative to the Site, is necessary to determine groundwater flow and contaminant source areas.*"^{38/} Subsequently, EPA installed thirteen monitoring wells primarily along Holt Road between Michigan Plaza and the Residential Area. AMMH also installed 8 monitoring wells in the area between the Michigan Plaza and the Residential Area. On December 6 and 7, 2011, EPA gauged 152 monitoring wells located throughout the area of the Residential Area and Michigan Plaza among others. The data were used to create the potentiometric surface maps presented as Figures 11 and 12 in the 2013 TM. The overlay of groundwater flow lines on those figures show that there is no groundwater flow from Michigan Plaza Source Areas to the Residential Area. Yet, EPA neither relies on these data nor explains the data away. Rather, it applies the above-described triangulation

^{36/} See *Technical Response* at Figures 24 and 26, respectively, which show that the water elevations at MMW-P-06 is consistent with the water elevations of surrounding wells in June and November 2009.

^{37/} *Id.* at 315.

^{38/} See 2011 TM at 23.

methodology in precisely the circumstance established groundwater hydrogeology authorities warn is risky.

III. CAP 18[®] INJECTIONS

A. Effect on Groundwater Flow Direction

EPA Comment. EPA alleges that there is insufficient data to conclude that the CAP 18[®] injections did not cause VC to migrate towards the Residential Area wells.^{39/} The Agency further alleges that the injection of CAP 18[®] mobilized PCE within the aquifer, which “*would also likely lead to increased concentrations of degradation daughter products TCE, cis-1,2 - DCE and vinyl chloride.*”^{40/}

Response. AMMH does not dispute that the CAP 18[®] injection activities induced some localized mobilization of PCE near the injections and increased the generation of daughter products. CAP 18[®] was injected at each location throughout the entire saturated zone and several feet above the groundwater table to place as much PCE as possible into solution so that treatment could be more efficacious. It is likely that this caused some PCE to move into the groundwater system, or that PCE very near the injection points could have migrated a few feet away from the injection points during the injections. In addition, as reductive dechlorination progresses following the CAP 18[®] injections, PCE and TCE are destroyed and cis-1,2-DCE and VC are expected to result. Ultimately, the cis-1,2-DCE and VC will be sequentially transformed as well. All of this occurs in the immediate vicinity of the injections and as the impacted groundwater flows downgradient (*i.e.*, south/southeast) away from the Michigan Plaza Source Areas.

As explained below, the *Technical Response* and new data collected during the third injection event this summer provide multiple lines of evidence that support the conclusion that the CAP 18[®] injection events did not affect groundwater levels significantly or change groundwater direction at the Michigan Plaza Site.

Data from 2007 Injection Event. As explained in the *Technical Response*, MUNDELL used a water level meter and an oil/water interface probe to measure water level changes and observe the presence of any CAP-18[®] on the groundwater surface in the vicinity of the injections locations prior to, during and subsequent to the August 2007 injection event. *See Technical Response* at Table 3. Had the specific injections caused significant changes in groundwater levels the data would reflect those changes; they do not. No measurable groundwater mounding effects or the presence of CAP 18[®] (*i.e.*, no rise in groundwater level of more than 0.01 feet or the presence of a measurable CAP 18[®] thickness of greater than 0.02 feet) beyond a radius of 10 feet from the point of injection was observed. Once water levels were adequately determined to

^{39/} EPA 2013 Comments at 5.

^{40/} *Id.* at 6.

be unaffected by the low flow injection rates, it was unnecessary to collect significant additional data as testing showed that no significant impacts close to the injection points were being observed.

Technical Response Calculations. The *Technical Response* also includes detailed calculations based on recognized groundwater hydrology methodology that demonstrate that: (1) the rise in groundwater level at a distance of 1 foot from the injection point would range between 0.27 and 0.31 feet; (2) the rise in groundwater level at a distance of 10 feet from the injection point would be between 0.12 and 0.16 feet; and (3) the rise in groundwater level at a 50 foot distance from the injection point would be negligible (<0.02 feet or less). The analysis also predicts that any small changes in groundwater levels that occurred at all would dissipate within a two hours or less after injections stopped at each location. *Technical Response* at 8. EPA has not offered any comments on the application of this methodology or the resulting calculations. Nor does EPA offer a specific technical basis or analysis that demonstrates the potential for these injections to produce a significant, sustained rise in water levels that could cause a sustained change in groundwater flow direction and gradient toward the Residential Area.

Data from the Third Injection Event. MUNDELL's protocol during the third injection was identical in all material respects to the protocol of the first and second injection events in terms of the depths of injection, the rates of injection, and the spacing between injection points. In addition, the volume of CAP 18[®] injected during the 2013 injection event (2,208 gallons) was very similar to the volume injected in 2009 (1,884 gallons).^{41/} In order to assess any impacts to groundwater flow that might arise as a result of the third round of CAP 18[®] injections, at IDEM's direction, MUNDELL conducted more comprehensive water level and CAP 18[®] measurements at selected locations in connection with that injection event.^{42/}

MUNDELL monitored the following 16 wells before, during and after the third round of injections: MMW-1S, MMW-9S, MMW-10S, MMW-P-01, MMW-P-02, MMW-P-07, MMW-P-11S/D, MMW-P-12S/D, MMW-P-13S/D, MMW-P-14S/D, and MW170S/D. In addition, transducers were placed in the network of sentinel monitoring points, and antecedent water level data were collected one week before CAP 18[®] injections commenced. Data were collected at a rate of one reading per minute. The transducer network remained in place during all injections. Water level measurements were also taken in selected relevant monitoring wells at greater distances with water level indicators at a rate of approximately once per hour. Water level measurements continued to be taken after the injections were completed until it had been determined that either 'no rise' in groundwater level has been observed, or the water level returned to pre-injection conditions.

^{41/} RWP at 83.

^{42/} *Id.* at 52-53.

As part of preparation of the Michigan Plaza RWP AMMH submitted to IDEM in September, the gauging data from the third injection event were thoroughly evaluated. ^{43/}Based on the review, some very limited, short-term mounding responses were observed in selected wells (e.g., MMW-P-02, MMW-P-12S/D and MMW-10S) very near (within 10 to 15 feet) to the injection locations. ^{44/} The mounding “spikes,” when they were observed, were present for no more than a couple of hours and then quickly dissipated. The maximum mounding that occurred was no greater than about 0.2 feet at a distance of less than 15 feet from the injection points. One anomalous transducer reading of a 1.7 foot increase in water level height for a period of about one hour was noted in monitoring well MMW-P-07 at Michigan Plaza. However, given the sudden rise and fall of this set of data, it is believed that these data at this one well were anomalous and not reflective of a mounding effect. Even if the brief rise in water level readings discussed above were somehow attributable to the injections, the mounding occurred to the southeast of Source Area B and was not sustained beyond an hour. In summary, the hydraulic response of the aquifer during the third round of injections was very consistent with the previous analysis MUNDELL provided to IDEM with respect to the first and second injections, which indicate that no significant mounding occurred during the injection activities, even in the immediate vicinity of the injections. In addition, whatever insignificant mounding was observed, it quickly dissipated within a few hours. The data collected during the third injection also confirmed that the injections did not alter the south-southeast groundwater flow direction from the Source Areas. ^{45/}

Monitoring wells utilized for water level measurements were also probed with an oil/water interface probe to determine the presence/absence of any CAP 18[®]. No significant movement of CAP 18[®] was observed away from the injection locations beyond what had been predicted prior to the injections. To provide additional longer-term water level data following the injection event, transducers were left in three monitoring wells (MMW-P-11S/D, MMW-P-13S/D, and MMW-P-14S/D) until the end of the third quarter in order to observe long-term water level fluctuations during the quarter following injections. Periodic measurements have also been made in these wells with an oil/water interface probe to monitor for the presence/absence of CAP 18[®]. AMMH plans to present this data in the 3rd Quarter Monitoring report to be submitted to IDEM at the end of October 2013. Based on the readings taken, no elevated groundwater level readings or movement of CAP18[®] have been observed in the data.

In summary, all data collected during each of the three injection events confirm that no significant and sustained rise in groundwater levels occurred as a result of the injection activities. As a result, groundwater flow directions were not observed to change in response to these

^{43/} *Id.* at 54-55.

^{44/} *Id.* at 55.

^{45/} *Id.* at 55.

activities. Based on these data and all previous analyses provided to EPA, we conclude that these injection remedial activities did not cause the transport of any chlorinated solvent concentrations to the west or southwest resulting in the observed chlorinated VOC concentrations in the Residential Area drinking water wells.

B. Use of Slug Test Data

EPA Comment. EPA criticizes AMMH's reliance on slug tests to assess the impact of CAP 18® injections: *"EPA (1994) has determined that slug test data are limited to the hydraulic conductivity of the area immediately surrounding the well tested, and may not be representative of the average hydraulic conductivity of the entire area. Therefore, it is incorrect for AMMH to draw conclusions about the average hydraulic conductivity for the entire site based on limited slug test data in a few monitoring wells."* ^{46/}

Response. Slug testing is a widely used and accepted investigative method to determine the hydraulic conductivity of saturated materials. The very textbook cited by EPA supports this: *"As an alternative to an aquifer test, a slug or bail-down test can be performed in a small-diameter monitor well. This type of test can be used to determine the hydraulic conductivity of the formation in the immediate vicinity of a monitor well."* ^{47/} The Technical Response did not state that these tests are accurate for every point in the study area and were not so intended. Rather, they were specifically conducted on those monitoring wells located between Michigan Plaza, MW-170S/D and the Residential Area (MMW-P-02, MMW-P-11S/DR, MMW-P-13S/D and MMW-P-14S/D). Technical Response at Table 3. Collectively, they provide reasonable ranges of values upon which to perform the analyses used to predict the impact of CAP 18® injections on the groundwater flow system in the upper sand aquifer.

C. Analysis of VC Detections at MW-170D

EPA Comment. EPA concedes that "low levels" of vinyl chloride contamination in MW-170D were not initially caused by AMMH's voluntary remediation but argues that vinyl chloride produced by the AMMH cleanup "could have arrived at MW -170D in as little as nine months (after the CAP-18 injections)."

Response. EPA bases its calculation of a nine month travel time on MUNDELL's slug testing, which it earlier argues cannot be used to calculate a "representative average hydraulic conductivity of the entire area." EPA 2013 Comments at 6. Further, rather than use the entire available slug test data, EPA uses only the maximum value for hydraulic conductivity (K) of 141 feet/day based on just one of 14 slug tests. That one slug test was the rising head test at MMW-P-14S which is screened in the shallow portion (18' – 28' bgl) of the upper sand aquifer. Technical Response at Table 3. Clearly, the maximum hydraulic conductivity used by EPA is

^{46/} EPA 2013 Comments at 6.

^{47/} Fetter, *supra* note 34, at 244.

not present throughout the area, and ignoring the remaining slug test data provides a skewed result.

Moreover, EPA's analysis assumes that groundwater flowed between the Michigan Plaza Source Areas and the Residential Area. None of the investigations or reviews performed by EPA/Weston, MUNDELL, ARCADIS, ENVIRON, IDEM and others has ever produced any scientifically sound data showing that MW-170D and the Residential Area are hydraulically downgradient from Michigan Plaza Source Areas A, B and C. Therefore, the hypothetical conjecture regarding travel time between the two sites is of no consequence.

IV. BLIND DRILLED WELLS

A. Till Units

EPA Comment. EPA indicates that it is confused by the *Technical Response's* references to an "upper glacial till surface" and that there is not enough data to support AMMH's claim that a continuous lower clay surface acts as a boundary to contaminant migration. EPA 2013 Comments at 8.

Response. In the *Technical Response*, MUNDELL/Minning depict the glacial till units as they have been determined by the available soil borings and the geophysical profiles that have been completed. *Technical Response* at 14. When the *Technical Response* refers to the 'upper glacial till' surface, it means the one that has been extensively mapped at depths of 32 to 38 feet (EL 675 to 685) below and downgradient from the 3 Michigan Plaza Source Areas. This is clearly depicted on the cross-sections presented as Figures 33, 34 and 35 in the *Technical Response*. The boring log for MMW-P-10A in the *Technical Response* shows that the "upper glacial till" was encountered between the depths of 38.5 and 40 feet bgl. Incorporating this into cross-section C-C' in Figure 35 of the *Technical Response* shows that the "window" in the glacial till layer as depicted in Figure 5 of the 2013 TM does not exist. Additional support for the presence of the glacial till layer in that area can be seen in the logs for MMW08S-A, which show that the glacial till layer was encountered from 38- 40 feet bgl, and in the logs for MMW-P-08A, which show that the glacial till was encountered at 36.1 – 40 feet bgl.

The only way to be 100% certain of the thickness of the glacial till layer would be to bore through it. However, sound hydrogeological investigation practices dictate that drilling through a glacial till layer that acts as a hydraulic barrier to the downward migration of contaminated groundwater should be avoided. In addition, drilling in excess of 200 CAP 18[®] injection locations identified the top of this glacial till and demonstrated that the glacial till is aerially extensive below and downgradient of Source Areas A, B and C as depicted in Figures 33, 34 and 35 in the *Technical Response*. This glacial till surface continued to be evident during the third injection round completed by MUNDELL in July 2013. Indeed, the cumulative soil boring data collected across the study area through July 2013 and subsequently utilized by MUNDELL in the

preparation of the RWP supports the position that this aerially extensive glacial till unit is present below the Source Areas. ^{48/}

V. 2013 SOIL GAS / GROUNDWATER QUALITY DATA

EPA Comment. Subsequent to receiving the EPA 2013 Comments, in an electronic message dated September 4, 2013, EPA provided data indicating that (a) it detected PCE in a single soil gas sample collected within the Residential Area in January, 2013, and (b) it detected PCE in a single groundwater monitoring well located between Michigan Plaza and the Residential Area in June 2013. The soil gas detection occurred at SG-10, and indicated PCE at 330 ppbv and TCE at 310 ppbv, both of which exceeded Vapor Intrusion Screening Levels (62 and 4 ppbv, respectively for PCE and TCE). The groundwater data indicated that PCE was detected in a groundwater sample from MW-WES-1c on June 28, 2013 at a concentration of 6.0 ug/L.

According to an electronic message from EPA that accompanied this additional data, *"[w]hen you combine the PCE detections in soil gas and groundwater, Michigan Plaza appears to be the most likely source."*

Response. When these new two data points (one soil gas, one groundwater) are evaluated in the context of the other data EPA collected during its January and June 2013 sampling events as well as other available data, it is clear they provide no support for EPA's assertion that PCE is migrating from the Michigan Plaza Site to the Residential Area across Holt Road.

With respect to the soil gas data, the detection of PCE at SG-10 was the only detection of PCE above VISLs out of the 15 locations EPA sampled in January 2013, all of which were located on the Michigan Plaza Site, in the Residential Area, or in the vicinity of the two.^{49/} In fact, at SG-9, which is located 400 feet to the east-northeast of SG-10 – near Holt Road and closer to Michigan Plaza – PCE was detected at only 1.3 ppbv. In addition, EPA's groundwater data from June 2013 show that the closest shallow groundwater monitoring well to SG-10, MW-WES-03a, did not contain any PCE at that time. Based on the soil gas data itself, it is apparent that the PCE detection at SG-10 is an isolated detection, likely attributable to localized conditions. This is also evident from the fact that, of the 28 chemical compounds analyzed for, 13 of those had their highest concentrations in the soil gas sample from SG-10. Those include 1, 2, 4-trimethylbenzene, 1, 3, 5- trimethylbenzene, 4-ethyltoluene, carbon disulfide, carbon tetrachloride (only in SG-10), ethylbenzene, m,p-xylene, propene, toluene and total xylenes.

^{48/} See RWP at Figure 8.

^{49/} TCE also was detected at the same location (310 ppbv) above its much lower VISL (4 ppbv), but at no other location. No other parameters were detected above VISLs at any of the 15 sampling locations.

None of these compounds are associated with drycleaner operations or have ever been associated with the Michigan Plaza Source Areas. 50/

EPA's reliance on its detection of 6.0 ug/L of PCE in groundwater at MW-WES-1c is similarly misplaced. The first thing to note is that MW-WES-1c is screened at a depth of between 50 and 55 feet bgl. According to the 2011 TM, the groundwater encountered at this depth is in an "intermediate water-bearing zone" ("IWBZ").51/ By contrast, the PCE contamination detected at Michigan Plaza has all been detected in the shallow portion of the upper sand aquifer, in well screens set on top of an aerially extensive upper glacial till. The 2011 TM refers to this shallower aquifer as the "Upper Water Bearing Zone" ("UWBZ") and explains that it is present to approximately 30 feet bgs, and underlain by a clay till of between 5 and 40 feet in thickness that "acts as a semi-confining unit" between the upper sand unit and the IWBZ. 52/ Since the 2011 TM was issued, AMMH has demonstrated that this glacial till layer that separates the UBWZ from the IBWZ is aerially extensive and continuous in the area of Michigan Plaza Source Areas A, B and C. 53/ Accordingly, the PCE detected in MW-WES-1c, at 50-55 feet bgl, is in a different aquifer (the IWBZ) than the contamination attributable to the Michigan Plaza Source Areas (the UWBZ).

Moreover, it is interesting to note that PCE was only detected in MW-WES-01c and not detected in any of the other 12 groundwater wells sampled by EPA's contractor in June 2013. This is consistent with prior findings as no PCE was detected in any of the thirteen Weston/EPA monitoring wells sampled by EPA's contractor in December 2011 in the same area. 54/ Around the same time EPA's contractor collected June 2013 data, MUNDELL collected groundwater samples from designated monitoring wells during the second quarter 2013 monitoring event in May 2013, including three well nests located between Michigan Plaza and EPA monitoring well MW-WES-01: MW-170S/D with screen settings at 17'-27' and 34'-39', MMW-P-13S/D with screen settings at 16'-26' and 28'-33', and MMW-P-14S/D with screen settings at 18'-28' and 29'-34'.55/ If the PCE detected in MW-WES-1c were migrating from the Michigan Plaza Source Areas, one would expect to see PCE in each of these wells or certainly in the deeper screened monitoring wells. But that is not what the data show. Instead, groundwater samples collected from all six of these wells contained no PCE (or TCE). Further, there have never been any PCE detections in any of the Michigan Plaza Site monitoring wells screened in the deeper portion of the upper sand aquifer.

50/ Unfortunately, in a departure from best practices, EPA failed to collect a sample of ambient air at the same time it collected the soil gas samples. Doing so might have provided useful information about possible surficial sources of PCE in the area of SG-09.

51/ 2011 TM at 7.

52/ *Id.*

53/ See *Technical Response* at 14 & Figures 33-35.

54/ See 2013 TM at Table 2 & 4.

55/ See MUNDELL 2Q 2013 Report at Table I.

Under these circumstances – one PCE detection in soil gas above standards out of 15 locations, a detection of PCE two orders of magnitude lower at the next location to the east (towards Michigan Plaza), the absence of PCE in groundwater samples in the upper sand aquifer in the vicinity of or towards Michigan Plaza, and a single, low concentration detection in a deep groundwater well – the detection of PCE in SG-10 and in MW-WES-1c provide absolutely no support for EPA's contention that groundwater contamination in the Residential Area is attributable to PCE releases at the Michigan Plaza Source Areas.

Finally, it is worth recalling that the presence of contamination in these locations is not indicative of a Michigan Plaza source unless there is a groundwater flow path from Michigan Plaza Source Areas to these locations. EPA did not collect groundwater elevation data in June, and it provided no potentiometric surface elevation contour map along with these most recent data. However, MUNDELL performed its second quarter 2013 groundwater gaging event on May 16, 2013 and the results are presented in the MUNDELL 2Q 2013 report along with potentiometric surface maps for the shallow and deep portions of the upper sand aquifer. ^{56/} Inferred groundwater flow lines for those figures clearly show the direction of groundwater flow from the Michigan Plaza Source Areas is to the southeast. This flow direction is consistent with every other potentiometric surface elevation map that has ever been prepared for the Michigan Plaza Site, the Residential Area and adjacent areas. **There is not now and never has been a flow path from the Michigan Plaza Source Areas to the Residential Area.**

VI. CONCLUSION

There has been a considerable amount of data generated for the Michigan Plaza Site, the Residential Area and surrounding facilities over the course of twelve years (2001 – 2013). Those data have been analyzed by a number of interested parties including EPA, IDEM, Genuine Parts, ATS and AMMH. When sound scientific principals are used to analyze those data, the results clearly demonstrate that the Michigan Plaza Source Areas are not the source of the chemical contamination detected in the private wells in the Residential Area.

^{56/} See *id.* at Figures 2A, 2B and 3.

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: GP-01

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: MD1046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Rick Davis

BORING LOCATION: Center of Michigan Plaza

FIELD GEOLOGIST: Leena Lothe & Jason Armour

NOTES: SL sample: GP-01-15.5'; 2 GW samples: GP-01-21' & GP-01-30'

DATE BEGAN: 08/18/04

PAGE 1 OF 2

DATE FINISHED: 08/18/04

DRILLING METHOD: Direct Push

DRILL EQUIP: Geoprobe 5400

GW DEPTH (OBSERVED): 19.0'

DEPTH OF BORING: 30.0'

TOP OF CASING ELEVATION: N/A

SURFACE ELEVATION: N/A

COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID	Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Well Completion Diagram
ASPHALT: About 3 inches of ASPHALT		0.2	5.1					0.0	
CRUSHED LIMESTONE: CRUSHED LIMESTONE, light olive brown (2.5 Y 5/6), dry, no odor			5.3						
			7.8		70%				
SAND: Fine to medium SAND with trace to some gravel - potential fill, light olive brown (2.5 Y 5/6), dry, no odor	SW	2.6	7.9						
CL: SILTY CLAY with trace to some sand, dark olive brown (2.5 Y 3/3), dry, slightly organic odor	CL	3.5	NA						
- slightly organic odor observed from about 4.5' to 5.0'			6.6					5.0	
SW: MEDIUM TO COARSE SAND with trace to some fine to medium gravel, light yellowish brown (2.5 Y 6/4), dry, no odor	SW	6.0	7.0		75%				
			7.8						
			NA						
			8.1						
SP: FINE TO MEDIUM SAND with trace coarse sand and fine gravel, light yellowish brown (2.5 Y 6/4), dry, no odor	SP	10.0	7.8		60%			10.0	
SW: MEDIUM TO COARSE SAND with trace to some fine to medium gravel, color changes back to light yellowish brown (2.5 Y 6/4), dry, no odor	SW	11.0	8.5						
- color change to dark yellowish brown (10 YR 4/6) beyond 11'			NA						
			7.1						
			8.5		75%				
			7.3					15.0	
			NA						
- color changes back to yellowish brown (2.5 Y 6/4) beyond 14.5'			NA						
SP: FINE TO MEDIUM SAND with trace silt and fine gravel, light yellowish brown (2.5 Y 6/4), dry - wet, no odor	SP	18.5	8.3		50%				
ML: SILT with trace sand and trace fine gravel, dark gray (2.5 Y 4/1), wet, no odor	ML	19.75	9.5					20.0	
SW: MEDIUM TO COARSE SAND with trace to some fine to medium gravel, gray (2.5 Y 5/1), dry - wet, no odor	SW	20.0	NA						
			NA						
			11.5						

MUNDELL & ASSOCIATES, INC.
BORING LOG

BORING NO: GP-01

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Rick Davis

BORING LOCATION: Center of Michigan Plaza

FIELD GEOLOGIST: Leena Lothe & Jason Armour

NOTES: SL sample: GP-01-15.5'; 2 GW samples: GP-01-21' & GP-01-30'

DATE BEGAN: 08/18/04

PAGE 2 OF 2

DATE FINISHED: 08/18/04

DRILLING METHOD: Direct Push

DRILL EQUIP: Geoprobe 5400

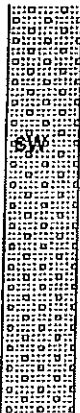

GW DEPTH (OBSERVED): 19.0'

DEPTH OF BORING: 30.0'

TOP OF CASING ELEVATION: N/A

SURFACE ELEVATION: N/A

COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Well Completion Diagram
		17.5		60%				
		30.0						
		NA					25.0	
		NA						
		17.5						
		21.9		55%				
		31.1						
<div style="display: flex; justify-content: space-between;"> - End of the Boring at 30'  </div>								

- End of the Boring at 30'

MUNDELL & ASSOCIATES, INC.








BORING LOG

BORING NO: GP-04

CLIENT: AIMCO
 PROJECT LOCATION: Indianapolis, Indiana
 PROJECT NAME: Michigan Meadows
 PROJECT NO: M01046
 DRILLING CONTRACTOR: American Drilling Services
 DRILLER: Rick Davis
 BORING LOCATION: SE Corner of the Plaza
 FIELD GEOLOGIST: Leena Lothe & Jason Armour
 NOTES: SS:GP-04 (16'); 1 GW sample:GP-04-22'

DATE BEGAN: 08/18/04
 DATE FINISHED: 08/18/04
 DRILLING METHOD: Direct Push
 DRILL EQUIP: Geoprobe 5400
 GW DEPTH (OBSERVED): 18.5'
 DEPTH OF BORING: 20.0'
 TOP OF CASING ELEVATION: N/A
 SURFACE ELEVATION: N/A
 COMMENTS:

PAGE 1 OF 1

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Well Completion Diagram
ASPHALT: About 3 inches of ASPHALT		0.25	4.5				0.0	
GRAVEL: about 6 inches of BASE COURSE		0.75	4.8					
CL: SILTY CLAY with trace medium to coarse sand, dark yellowish brown (10 YR 3/4), slightly moist, no odor			5.8	80%				
SW: FINE TO COARSE SAND with trace to some fine gravel, dark brown (10 YR 4/3), dry, no odor		3.5	5.5					
			6.5					
			6.5	85%			5.0	
			8.0					
			7.2					
			6.2					
SP: FINE TO MEDIUM SAND with trace silt, dark yellowish brown (10 YR 4/4), dry, no odor		9.5	10.2	80%			10.0	
			8.8					
			7.2					
SW: FINE TO COARSE SAND with trace to some fine gravel, dark yellowish brown (10 YR 4/3) with intermittent orange-red orange coloration observed - maybe Iron, dark brown (10 YR 3/3) with occasional orange-red (2.5 YR 5/8) coloration, dry, no odor		11.5	NA					
			11.3	75%				
			15.1				15.0	
- color change to brownish yellow (10 YR 6/8) at 15'			13.0					
			5.2					
			4.8	50%				
SP: FINE TO COARSE SAND, dark yellowish brown (10 YR 3/4), slightly wet, no odor		18.5	6.9					
			7.1				20.0	
- End of the Boring at 22'		20.0						



Boring/Well ID: GP-21

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/7/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/7/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 21.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-21
0			Grass/Topsoil	.50	0.1				
1	CL		SILTY CLAY with gravel, dark brown (10YR 3/3), soft, dry			25			
2			No Recovery 1.0 - 4.0 ft						
3									
4	SW		SAND with trace gravel, well graded, brown (10YR 5/3), loose, moist	4.0					
5				5.0	0.2				
6	SW-GW		SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist			50			
7			No Recovery 6.0 - 8.0 ft						
8				8.0					
9	SW-GW		SAND and GRAVEL, well graded, yellowish red (5YR 5/8), dense, moist		0.2				
10						100			
11					0.2				
12	SW		Fine to medium grained SAND with trace gravel, well graded, brown (10YR 5/3), dense, moist	12.0					
13					0.2				
14	SW-GW		SAND and GRAVEL, well graded, yellowish red (5YR 5/8), dense, moist	13.5					
15	SW		Fine to medium grained SAND with trace gravel, well graded, brown (10YR 5/3), moist, dense	14.0		100			
16				15.5	0.2				
17	SW-GW		SAND and GRAVEL, well graded, yellowish red (5YR 5/8), dense, moist		0.2				
18						100			
19					0.2				
20				20.0					
21	SM		Fine grained SANDY SILT with trace gravel, grayish brown (10YR 5/2), dense, wet		0.2				
22						100			
23					0.2				
24									

2" Dia. Borehole

Soil Sample:
GP-21 18-20'

REMARKS:

BGS = Below Ground Surface
 USCS = Unified Soil Classification System
 TPV = Total Photoionizable Vapors
 NS = Not Surveyed



Boring/Well ID: GP-21

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/7/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/7/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 21.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 2 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-21		
24	SM		Fine grained SANDY SILT, coarsens with depth, grayish brown (10YR 5/2), stiff, wet		0.2						
25						100					
26	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), dense, wet	26.5	0.2		*	Water Sample: GP-21 28'			
27											
28	SW		SAND with trace gravel, well graded, grayish brown (10YR 5/2), dense, wet	28.0							
29											
30	GW		GRAVEL, well graded, grayish brown (10YR 5/2), dense, wet	29.0	0.5						
31						No Recovery 30.0 - 32.0 ft				-	50
32	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), dense, wet	32.0					2" Dia. Borehole		
33						0.3					75
34						0.3					
35	SW		No Recovery 35.0 - 36.0 ft								
36						-					
37						36.0				0.4	
38	SW		Fine to medium grained SAND with trace gravel, gray (2.5Y 5/1), dense, wet								
39						No Recovery 39.0 - 40.0 ft				-	
40	CL		SILTY CLAY with trace gravel, gray (2.5Y 5/1), stiff, moist	40.0			*	Soil Sample: GP-21 40-42			
41						0.3					
42						100					
43					0.3						
44						44.0					
45	End of boring at 44.0 ft										
46											
47											
48											

REMARKS:
 BGS = Below Ground Surface
 USCS = Unified Soil Classification System
 TPV = Total Photoionizable Vapors
 NS = Not Surveyed

2" Dia. Borehole



Boring/Well ID: GP-23

CLIENT: AIMCO

FIELD SCIENTIST: Sarah Webb, L.P.G.

PROJECT LOCATION: Indianapolis, Indiana

DATE BEGAN: 12/8/11

PROJECT NAME: Michigan Meadows Apts

DATE FINISHED: 12/8/11

PROJECT NUMBER: M01046

DRILLING METHOD: Direct Push

DRILLING CONTRACTOR: Earth Exploration

DRILLING EQUIPMENT: Geoprobe 6620

DRILLER: Sam Barthalow

GW DEPTH (OBSERVED): 20.5 ft

BORING LOCATION: Cemetery

SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-23
0			Grass/Topsoil	50					
1			SILTY CLAY with trace gravel, brown (10YR 5/3), soft, moist		0.3				
2	CL					50			
3			No Recovery 2.0 - 4.0 ft						
4			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist	4.0					
5					0.4				
6						75			
7			No Recovery 7.0 - 8.0 ft		0.6				
8									
9					0.4				
10	SW-GW					75			
11			No Recovery 11.0 - 12.0 ft		0.3				
12									
13					0.4				
14			yellowish red (5YR 5/9) oxidation at 14.0 ft			75			
15			No Recovery 15.0 - 16.0 ft		0.5				
16				16.0					
17			SAND and GRAVEL, well graded, brownish gray (10YR 6/2), loose, moist		0.1				
18	SW-GW		silty clay seam at 17.0 ft			75	*	Soil Sample: GP-23 17-19	
19			No Recovery 19.0 to 20.0 ft		0.3				
20				20.0					
21	SW		SAND, well graded, brownish gray (10YR 6/2), loose, wet		0.1	75			
22	SW		wet at 20.5 ft	21.5					

2" Dia. Borehole

REMARKS:

BGS = Below Ground Surface

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TPV = Total Photoionizable Vapors

NS = Not Surveyed



Boring/Well ID: GP-23

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/8/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/8/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 20.5 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 2 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-23
22					0.2				
23	SW		No Recovery 23.0 - 24.0 ft		-	75			
24			GRAVEL with coarse grained sand, well graded, brownish gray (10YR 6/2), dense, wet	24.0					
25					0.1				
26	GW		yellowish red (5YR 5/8) silt seam at 26.0 ft			75			
27			No Recovery 27.0 - 28.0 ft		0.2		*	Water Sample: GP-23 27'	
28	SW		Medium to coarse grained SAND with trace gravel, yellowish red (5YR 5/8), dense, wet	28.0					
29			GRAVEL with trace sand, well graded, yellowish red (5YR 5/8), dense, wet	28.5	0.2				
30	GW		cobble seam from 29.5 - 30.5 ft		0.2	63			
31			No Recovery 30.5 - 32.0 ft						
32			GRAVEL, well graded, yellowish red (5YR 5/8), dense, wet	32.0					
33	GW				0.1				
34			SAND and GRAVEL, well graded, brownish gray (10YR 6/2), dense, wet	34.0		100			
35	SW-GW				0.1				
36			SAND and GRAVEL, well graded, gray (2.5Y 5/1), dense, wet	36.0					
37	SW-GW				0.1		*	Water Sample: GP-23 37'	
38				38.5		88			
39	CL		SILTY CLAY with trace gravel, gray (2.5Y 5/1), stiff, moist		0.1		*	Soil Sample: GP-23 39-40'	
40			No Recovery 39.5 - 40.0 ft	40.0					
41			End Of Boring at 40.0 ft						
42									
43									
44									

2" Dia. Borehole

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NS = Not Surveyed



Boring/Well ID: GP-24

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/12/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/12/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthelow	GW DEPTH (OBSERVED): 22.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 1 OF 3

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-24
0			Grass/Topsoil	.50					
1	CL		SILTY CLAY with trace gravel, brown (10YR 5/3), soft, moist		1.3				
2						50			
3			No Recovery 2.0 - 4.0 ft		-				
4				4.0					
5			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist		1.1				
6	SW-GW					50			
7			No Recovery 6.0 - 8.0 ft		-				
8				8.0					
9	SW		Fine to medium grained SAND, well graded, brown (10YR 5/3), loose, moist		1.0				
10				10.0		75			
11			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist, yellowish red (5YR 5/8) oxidation at 11.0 ft		1.0				
12			No Recovery 11.0 - 12.0 ft		-				
13					1.0				
14	SW-GW					75			
15			No Recovery 15.0 - 16.0 ft		1.0				
16					-				
17					0.9				
18	CL		SILTY CLAY with trace sand, brownish gray (10YR 6/2), soft, moist	17.5		75		Soil Sample: GP-24 17-19'	
19	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), loose, moist	18.0	0.7				
20					-				

2" Dia. Borehole

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Boring/Well ID: GP-24

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/12/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/12/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthelow	GW DEPTH (OBSERVED): 22.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 2 OF 3

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-24
20	SW		Fine to medium grained SAND, well graded, brownish gray (10YR 6/2), loose, moist	22.0	0.8	100			
21									
22	SW-GW		SAND and GRAVEL, brownish gray (10YR 6/2) loose, wet	22.0	0.9	88	*	Water Sample: GP-24 28'	2" Dia. Borehole
23			wet at 22.0 ft						
24					0.8				
25									
26					0.8				
27			No Recovery 27.5 - 28.0 ft		-				
28									
29					0.9				
30									
31			No Recovery 31.0 - 32.0 ft		-				
32						100		Water Sample: GP-24 38'	
33					0.7				
34									
35					1.0				
36			SAND and GRAVEL, coarsens with depth, 36.0 - 40.0 ft						
37					0.9				
38									
39					1.0				
40									

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Boring/Well ID: GP-24

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/12/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/12/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthelow	GW DEPTH (OBSERVED): 22.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 3 OF 3

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-24
40	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), dense, wet	44.0	0.4	100			2" Dia. Borehole
41									
42					0.4				
43									
44			Sand heave refusal at 44.0 ft						
45			End Of Boring at 44.0 ft						
46						0			
47			Pushed to 48.0 ft to collect a water sample from the deep saturated zone	48.0			*	Water Sample: GP-24 48'	
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

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Boring/Well ID: GP-28

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/9/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/9/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 20.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-28
0			Grass/Topsoil	.50					
1	CL		SILTY CLAY with some sand and gravel, brown (10YR 5/3), soft, moist	1.5	0.9				
2						75			
3	SW-GW		No Recovery 3.0 - 4.0 ft		-				
4			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist						
5	SW		No Recovery 2.0 - 4.0 ft	4.5	0.8				
6			Medium to coarse grained SAND with trace gravel, well graded, brown (10YR 5/3), loose, moist	5.5		75			
7			yellowish red (5YR 5/8) oxidation from 4.5 -5.5 ft		1.0				
8	SW-GW		SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist		-				
9			No Recovery 7.0 - 8.0 ft						
10					0.9				
11	SW		Fine to medium grained SAND with some gravel, well graded, brown (10YR 5/3), loose, moist	10.5	0.9				
12			yellowish red (5YR 5/8) oxidation from 10.5 - 11.0 ft	12.0					
13	SW-GW		No Recovery 11.0 - 12.0 ft		0.7				
14			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist	14.0		75			
15			SAND with trace gravel, well graded, brown (10YR 5/3), dense, moist		0.8				
16	SW		No Recovery 15.0 - 16.0 ft		-				
17			yellowish red (5YR 5/8) oxidation from 16.0 - 18.0 ft		0.7				
18				18.0		100			
19	SW-GW		Medium to coarse grained SAND and GRAVEL, well graded, brownish gray (2.5Y 5/1), moist		0.6			Soil Sample: GP-28 17-19'	
20					-				

2" Dia. Borehole

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Boring/Well ID: GP-28

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/9/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/9/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 20.0 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 2 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-28
20	SW-GW		SAND and GRAVEL, well graded, gray (2.5Y 5/1), dense, wet	21.0	0.6				
21	SW-GW		-Wet at 20.0 ft	22.0	0.7	75			
22			Medium to coarse grained SAND and GRAVEL, gray (2.5Y 5/1), dense, wet						
23	SW-GW		SAND and GRAVEL, well graded, gray (2.5Y 5/1), dense, wet	24.0	-				
24			No Recovery 23.0 - 24.0 ft						
25	GW		GRAVEL, well graded, gray (2.5Y 5/1), dense, wet	25.5	0.4				
26	CL		SILTY CLAY with some gravel, brownish gray (10YR 6/2), stiff, moist	26.5	0.8	100			
27			SILTY SAND and GRAVEL, brownish gray (10YR 6/2), dense, wet						
28								Water Sample: GP-28 28'	
29	SM-GM				0.8				
30						50			
31			No Recovery 30.0 - 32.0 ft						
32			Silty SAND and GRAVEL, gray (2.5Y 5/1), dense, wet	32.0	0.9				
33	SM-GM					100			
34									
35	SW		Fine to coarse grained SAND, gray (2.5Y 5/1), very dense, wet	35.0	0.9				
36			Sand heave refusal at 36.0 ft	36.0					
37			End of Boring at 36.0 ft			0			
38			Pushed to 38.5 ft to collect a water sample from the deep saturated zone					Water Sample: GP-28 38.5'	
39									
40									

2" Dia. Borehole

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Boring/Well ID: GP-30

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/13/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/13/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 18.5 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-30
0			Grass/Topsoil	.50					
1			SILTY CLAY with trace sand, brown (10YR 5/3), loose, moist		0.2				
2			Hand augered to 5.0 ft			100			
3	CL								
4					0.2				
5			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist	5.0	0.3				
6						100			
7			yellowish red (5YR 5/8) oxidation from 5.0 - 10.5 ft		0.4				
8									
9	SW-GW				0.4				
10					0.4	63			
11			No Recovery 10.5 - 12.0 ft		-				
12	SW		SAND with trace gravel, well graded, brown (10YR 5/3), dense, moist	12.0					
13			SAND and GRAVEL, well graded, brown (10YR 5/3), dense, moist	13.0	0.5				
14						100			
15	SW-GW		yellowish red (5YR 5/8) oxidation from 13.0 - 16.0 ft		1.4				
16			Fine to medium grained SAND seam with trace gravel	16.0					
17	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), loose, moist		0.6				
18			Fine to medium grained SAND, well graded, brownish gray (10YR 6/2), loose, moist	17.5		88			
19	SW		Wet at 18.5 ft		0.3				
20			No Recovery 19.5 - 20.0 ft		-				

2" Dia. Borehole

Soil Sample:
GP30 16-18'



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Boring/Well ID: GP-30

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/13/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/13/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 18.5 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS
SHEET 2 OF 2	

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-30			
20	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), loose, wet		1.2	63	*	Water Sample: GP-30 25'				
21			Becomes finer grained with depth to 22.5 ft		2.2							
22												
23			No Recovery 22.5 -24.0 ft		-							
24			No longer becoming finer grained with depth		2.4	50						
25					1.4							
26					-							
27			No Recovery 26.0 - 28.0 ft		1.5	25						
28					-							
29												
30	CL		No Recovery 29.0 - 32.0 ft		2.5	88	*	Water Sample: GP-30 35' Soil Sample: GP-30 34-35.5'				
31					2.0							
32				35.0	-							
33				36.0	-							
34			SILTY CLAY with trace sand, gray (2.5Y 5/1), very stiff									
35			No Recovery 35.5 -36.0 ft	35.0								
36			End of Boring at 36.0 ft	36.0	-		*					
37												
38												
39												
40												

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Boring/Well ID: GP-31

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/13/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/13/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 18.5 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-31
0			Grass/Topsoil	.50					
1			SILTY CLAY with trace sand, brown (10YR 5/3), loose, moist		0.2				
2			Hand augered to 5.0 ft			100			
3	CL				0.2				
4									
5									
6				6.0	0.3	75			
7			SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist						
8	SW-GW		yellowish red (5YR 5/8) oxidation from 6.0 - 7.5 ft		-				
9			No recovery 7.0 - 8.0 ft		0.4				
10				9.5	0.4	63			
11	SW-GW		SAND and GRAVEL, well graded, brown (10YR 5/3), loose, moist						
12			No Recovery 10.5 - 12.0 ft		-				
13				12.0	0.5				
14	SW-GW		SAND and GRAVEL, well graded, brown (10YR 5/3), dense, moist		0.7	63			
15			yellowish red (5YR 5/8) oxidation from 12.0 - 14.5 ft						
16			No Recovery 14.5- 16.0 ft		-				
17	SW		SAND, well graded, brown (10YR 5/3), loose, moist	16.0	2.1				
18			silty sand seam at 16.5 ft						
19	SW		SAND, well graded, brown (10YR 5/3), dense, wet	17.5	1.1	75			
20			Wet at 18.5 ft						
			No Recovery 19.0 - 20.0 ft		-				

2" Dia. Borehole

Soil Sample:
GP-31 16-17.5'

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Boring/Well ID: GP-31

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/13/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/13/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 18.5 ft
BORING LOCATION: Cemetery	SURFACE ELEVATION: NS

SHEET 2 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	GP-31			
20	SW-GW		SAND and GRAVEL, well graded, brownish gray (10YR 6/2), loose, wet	32.0	4.1	75	*	Water Sample: GP-31 26'	<div></div> 2" Dia. Borehole			
21			Well graded sand seam at 21.5 ft		2.2							
22			No Recovery 23.0 -24.0 ft		-							
23					1.5	88						
24					1.4							
25			No recovery 27.5 - 28.0 ft		-							
26					0.4	100						
27					0.5							
28												
29												
30			End of Boring at 32.0 ft due to lost geoprobe tooling									
31												
32												
33												
34						0						
35			Pushed to 36.0 ft to collect a water sample from the deep saturated zone				*	Water Sample: GP-31 36'				
36												
37												
38												
39												
40												

REMARKS:

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NS = Not Surveyed

MUNDELL & ASSOCIATES, INC.


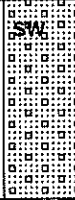


BORING LOG

BORING NO: GP-C-01

PAGE 1 OF 1

CLIENT: AIMCO
PROJECT LOCATION: Indianapolis, Indiana
PROJECT NAME: Michigan Meadows
PROJECT NO: M01046
DRILLING CONTRACTOR: Midway Services, Inc.
DRILLER: Mark Hicks
BORING LOCATION: West side of Olin Ave. North of Cossell Rd.
FIELD GEOLOGIST: Leena Lothe & April Nelson
NOTES: 1 GW sample: GP-C-01 (20'); 2 SS: 7-8", 18-19'

DATE BEGAN: 1/12/07
DATE FINISHED: 1/12/07
DRILLING METHOD: Direct Push
DRILL EQUIP: Geoprobe 5400
GW DEPTH (OBSERVED): 19'
DEPTH OF BORING: 20'
TOP OF CASING ELEVATION: N/A
SURFACE ELEVATION: N/A
COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information				
ASPHALT: 3" of ASPHALT		0.25	0.1	75%	★		0.0					
FILL: 9" of FILL gravel, BASE COURSE		1.00	0.1									
CL: SILTY CLAY with trace sand, dark gray (10 yr 3/1), slightly moist			0.1									
			0.1	50%								
			0.1				5.0					
			0.1									
SW: FINE TO COURSE SAND with trace to some fine with occasional orange color (2.5 yr 5/8)		7.50	2.1	50%								
- Black staining observed (10 yr 2/1) @ 8'			0.1									
			0.1				10.0					
			4.4									
		2.7										
		0.1		50%								
SP: FINE TO MEDIUM SAND with trace silt and gravel		13.00	0.1									
			2.6									
			0.1				15.0					
			0.7				60%					
SW: FINE TO COURSE SAND with trace silt and gravel, slightly moist, no odor		17.00	0.1									
			0.1									
			0.1	20.0								
- End of Boring at 20'		20.00			★							

MUNDELL & ASSOCIATES, INC.
BORING LOG

BORING NO: GP-C-07

PAGE 1 OF 2

CLIENT: AIMCO
 PROJECT LOCATION: Indianapolis, Indiana
 PROJECT NAME: Michigan Meadows
 PROJECT NO: M01046
 DRILLING CONTRACTOR: Midway
 DRILLER: Mark Hicks
 BORING LOCATION:
 FIELD GEOLOGIST: Leena Lothe & Gabriel Herbert
 NOTES: SS:GP-C-07 (16')(19')(24')

DATE BEGAN: 7/31/08
 DATE FINISHED: 7/31/08
 DRILLING METHOD: Geoprobe/ Direct Push
 DRILL EQUIP: Geoprobe
 GW DEPTH (OBSERVED):
 DEPTH OF BORING: 24'
 TOP OF CASING ELEVATION: N/A
 SURFACE ELEVATION: N/A
 COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Readings	Rec. %	Sample Location	Sample ID	Depth (feet)	Notes
GC: brown silt, (10YR 4/3)			1.3				0.0	
				75%				
			2.3					
			1.2				5.0	
		6'						
SP: fine to med sand w/ trace gravel, dry, slight odor (10YR 5/8)			1.8	60%				
			1.7					
		10'					10.0	
SW: slight odor (10YR 4/4) at 10'			0.9	80%				
		12'						
gravel layer, slight odor at 12'			1.3					
		15'					15.0	
black color, orange color, sugar odor, dry (10YR 5/6) at 15'			3.5					
			1.6			GP-C-07 (16')		
						GP-C-07 (18')		
			1.8					

wet at 20'

End of Boring

20'

1.8

0.6



GP-C-07 (24')

20.0

25.0

30.0

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: GP-C-08

PAGE 1 OF 2

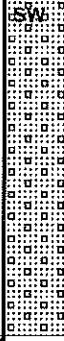
CLIENT: AIMCO
PROJECT LOCATION: Indianapolis, Indiana
PROJECT NAME: Michigan Meadows
PROJECT NO: M01046
DRILLING CONTRACTOR: Midway
DRILLER:
BORING LOCATION:
FIELD GEOLOGIST: Leena Lothe & Gabriel Herbert
NOTES: SS:GP-C-08 (6')(20')(24')

DATE BEGAN: 7/31/08
DATE FINISHED: 7/31/08
DRILLING METHOD: Geoprobe/ Direct Push
DRILL EQUIP:
GW DEPTH (OBSERVED): 20'
DEPTH OF BORING: 24'
TOP OF CASING ELEVATION: N/A
SURFACE ELEVATION: N/A
COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Readings	Rec. %	Sample Location	Sample ID	Depth (feet)	Notes
GRASS: grass, topsoil 1"							0.0	
CL: silty clay w/ trace sand, dry, no odor (2.5 YR 3/3)	CL	3'	0.7	60%				
SP: fine sand w/ trace to medium gravel			1.4					
			1.7				5.0	
			1.4	70%				
			1.2					
SP: fine sand w/ trace gravel, dry, slight odor (2.5Y 4/4) at 10'		10'	0.7	70%			10.0	
		13'	2.0					
SW: 13' fine sand w/ trace gravel, no odor, dry.			1.3	70%			15.0	
		18'	0.8					
orange color at 18'			0.4	80%				

wet at 20'

End of Boring



20'

0.8

20%



GP-C-08 (20')

20.0



GP-C-08 (24')

25.0

30.0



MUNDELL & ASSOCIATES, INC.
BORING LOG

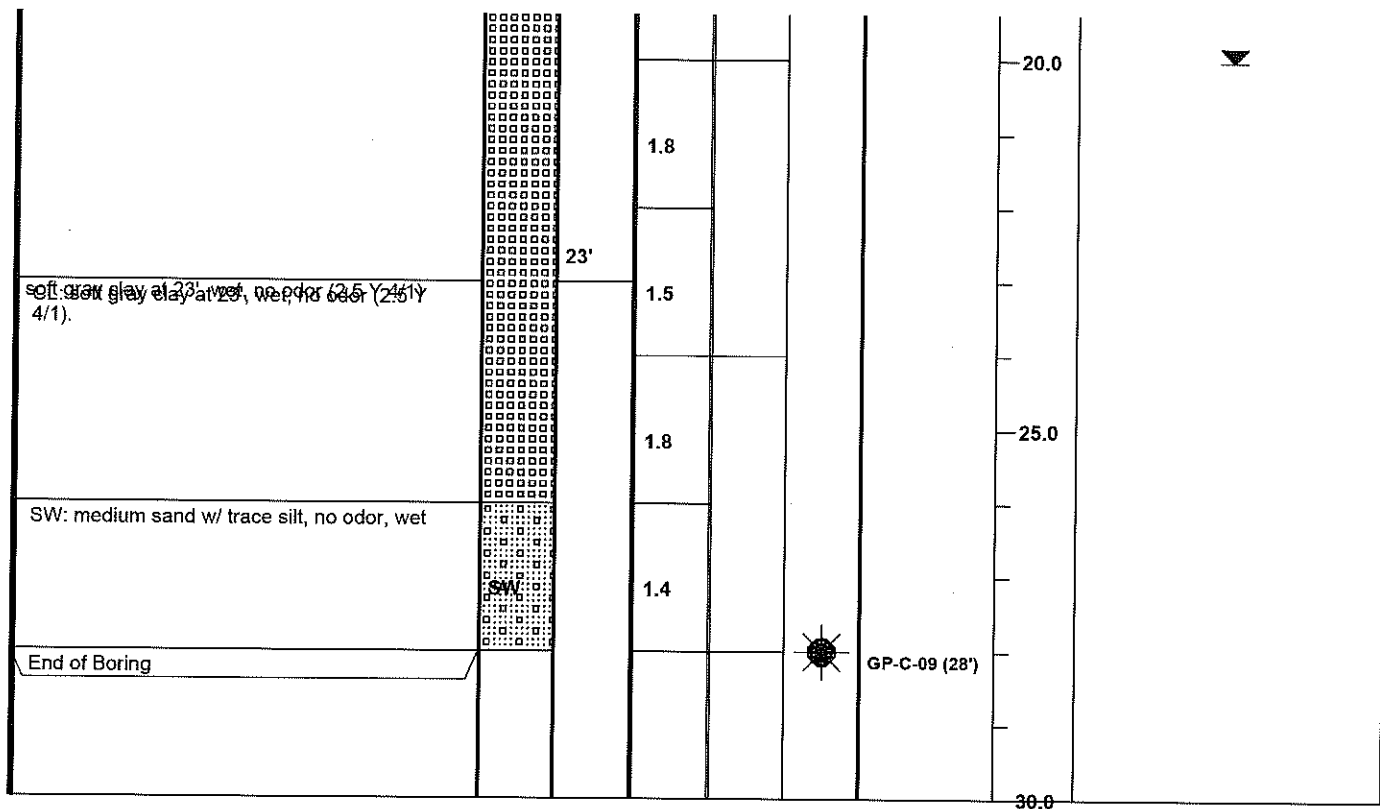
BORING NO: GP-C-09

PAGE 1 OF 2

CLIENT: AIMCO
 PROJECT LOCATION: Indianapolis, Indiana
 PROJECT NAME: Michigan Meadows
 PROJECT NO: M01046
 DRILLING CONTRACTOR: Midway
 DRILLER:
 BORING LOCATION:
 FIELD GEOLOGIST: Leena Lothe & Gabriel Herbert
 NOTES: SS:GP-C-09 (8')(18')(28')

DATE BEGAN: 8/1/2008
 DATE FINISHED: 8/1/2008
 DRILLING METHOD:
 DRILL EQUIP:
 GW DEPTH (OBSERVED): 20'
 DEPTH OF BORING: 28'
 TOP OF CASING ELEVATION: N/A
 SURFACE ELEVATION: N/A
 COMMENTS:

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Readings	Rec. %	Sample Location	Sample ID	Depth (feet)	Notes
Grass: topsoil 2"							0.0	
CL: clay w/ trace to some sand, no odorm dry, (7.5YR 4/3).	CL	3'	1.2					
SW: fine to medium sand w/ trace gravel, dry, no odor (10YR 6/4)	SW		1.4					
			1.9				5.0	
			2.0					
		10'	1.8		GP-C-09 (8')			
SP: fine to medium sand w/ trace gravel, dry, no odor (10YR 6/4)	SP		2.1				10.0	
gravel with pebbles at 13'		13'	2.0					
			2.5				15.0	
			2.4					
wet at 18'		18'			GP-C-09 (18')			
			1.9					





Boring/Well ID: MMW-C-02D

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/5/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/6/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 20.0 ft
BORING LOCATION: S. of Plaza	SURFACE ELEVATION: NS

SHEET 1 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	MMW-C-02D
0			Grass/Topsoil	.50	1.8	75			
1	SM		SILTY SAND with trace of gravel, brown (10YR 5/3), dense, moist		2.1				
2									
3			No recovery 3.0 - 4.0 ft						
4				4					
5	SW		SAND with trace gravel, well graded, brown (10YR 5/3), loose, dry		1.6	100			
6									
7					1.1				
8				8					
9			Fine to medium grained SAND with trace gravel, well graded, brown (10YR 5/3), loose, dry		1.7	100			
10									
11					1.9				
12	SM								
13					2.4	100			
14									
15					2.0				
16									
17					1.0				
18			Fine to medium grained SAND, poorly graded, brown (10YR 5/3), dense, moist	17.5	1.1	75			Soil Sample: MMW-C-02D 17.5-19.0'
19			yellowish red (5YR 5/8) oxidation from 17.5 - 19.0 ft						
20			No Recovery 19.0 - 20.0 ft						
21	SP		Wet at 20.0 ft		0.9	50			Water Sample: MMW-C-02D 22.0'
22			Significant sand heaving problems from 20.0 - 22.0 ft						
23			No Recovery 22.0 - 24.0 ft						
24									

2" Dia. Borehole

Bentonite Seal

2" PVC Riser

REMARKS:

BGS = Below Ground Surface
USCS = Unified Soil Classification System
TPV = Total Photoionizable Vapors
NS = Not Surveyed

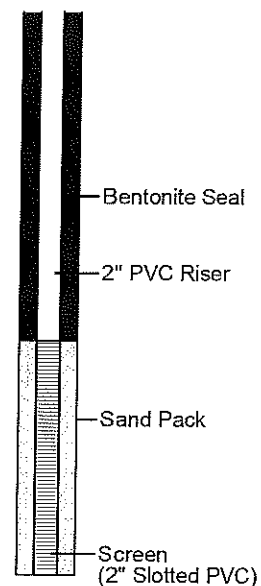


Boring/Well ID: MMW-C-02D

CLIENT: AIMCO	FIELD SCIENTIST: Sarah Webb, L.P.G.
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 12/5/11
PROJECT NAME: Michigan Meadows Apts	DATE FINISHED: 12/6/11
PROJECT NUMBER: M01046	DRILLING METHOD: Direct Push
DRILLING CONTRACTOR: Earth Exploration	DRILLING EQUIPMENT: Geoprobe 6620
DRILLER: Sam Barthalow	GW DEPTH (OBSERVED): 20.0 ft
BORING LOCATION: S. of Plaza	SURFACE ELEVATION: NS

SHEET 2 OF 2

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Sample ID	MMW-C-02D
24			Fine to coarse grained SAND and GRAVEL, well graded, gray (2.5Y 5/1), dense, wet		0.6	100			
25					0.4				
26									
27					0.6	100			
28					0.5				
29					0.2	100			
30	SW-GW		Significant sand heaving problems from 28.0 - 36.0 ft		0.1				
31									
32							*	Water Sample: MMW-C-02D 32.0'	
33									
34									
35									
36			SILTY CLAY, Gray (2.5YR 5/1) very stiff, moist	36	0.1	100			
37	CL				0.1				
38									
39									
40							*	Soil Sample: MMW-C-02D 40.0 - 42.0'	
41	CL		SILTY CLAY, gray (2.5Y 5/1), very stiff, moist	40	0.2	100			
42							*	Water Sample: MMW-C-02D 42.0'	
43			End of Boring at 42.0 ft						
44									
45									
46									
47									
48									



REMARKS:

BGS = Below Ground Surface
USCS = Unified Soil Classification System
TPV = Total Photoionizable Vapors
NS = Not Surveyed

MUNDELL & ASSOCIATES, INC.
BORING LOG

BORING NO: MMW-4D

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: Grass Area NW of basketball pole

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-4D collected at 9 - 10'

DATE BEGAN: 08/25/04

PAGE 1 OF 3

DATE FINISHED: 08/25/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 11.5'

DEPTH OF BORING: 66'

TOP OF CASING ELEVATION: 711.64

SURFACE ELEVATION: N/A

COMMENTS: Sand heaving, drillers washing split spoon, spl. 8

[illegible]

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-4D

PAGE 2 OF 3

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: Grass Area NW of basketball pole

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-4D collected at 9 - 10'

DATE BEGAN: 08/25/04

DATE FINISHED: 08/25/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 11.5'

DEPTH OF BORING: 66'

TOP OF CASING ELEVATION: 711.64

SURFACE ELEVATION: N/A

COMMENTS: Sand heaving, drillers washing split spoon, spl.

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
		23.0						
			4.7					
SW: FINE TO MEDIUM SAND with trace to some fine to medium gravel, moist, no odor		25.0	6.4	100%			25.0	
		28.0						
		29.0	8.0					
		30.0	8.1	90%			30.0	
GM: SANDY GRAVELS, GRAVEL-SAND-SILT mixtures, wet, no odor								
SW: FINE TO MEDIUM SAND with trace to some silt, and trace to some gravel, wet, no odor			7.5					
SM: SILTY SANDY CLAYEY mixture			7.4	85%			35.0	
- stone chips & pebbles noted at 35.5'								
SW: FINE TO MEDIUM SAND with some clay (soft), wet, no odor			6.0					
			9.2	65%			40.0	
- cobble chips layer observed at 40', 45', and at 50' (3-4 inches of cobble at 50')								
			8.4					
				55%			45.0	

Riser

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-4D

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: Grass Area NW of basketball pole

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-4D collected at 9 - 10'

DATE BEGAN: 08/25/04

PAGE 3 OF 3

DATE FINISHED: 08/25/04

DRILLING METHOD: HSA with 4" Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 11.5'

DEPTH OF BORING: 66'

TOP OF CASING ELEVATION: 711.64

SURFACE ELEVATION: N/A

COMMENTS: Sand heaving, drillers washing split spoon, spl. 51

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
------------------------	----------------	----------------------------	---------------------------	--------	--------------------	-----------	-----------------	-------------------------

			38					
			12.3					
			10.2	55%			50.0	
			7.0					
			10.1	75%			55.0	
			6.1					
			11.0	90%			60.0	
			3.5					
			4.9	60%			65.0	
CL: HARD COMPACT CLAY, with trace to some sand, moist, no odor	CL							
- End of the Boring at 66'								

Sand
Pack

Screen

Sump
(Riser
with a
cap)

MUNDELL & ASSOCIATES, INC.
BORING LOG

BORING NO: MMW-5D

CLIENT: AIMCO

DATE BEGAN: 08/24/04

PAGE 1 OF 3

PROJECT LOCATION: Indianapolis, Indiana

DATE FINISHED: 08/24/04

PROJECT NAME: Michigan Meadows

DRILLING METHOD: HSA with 4' Geoprobe Sampler

PROJECT NO: M01046

DRILL EQUIP: CME 70

DRILLING CONTRACTOR: American Drilling Services

GW DEPTH (OBSERVED): 12.0'

DRILLER: Bernie Byers

DEPTH OF BORING: 51'

BORING LOCATION: Central area of the northern fence line

TOP OF CASING ELEVATION: 711.75

FIELD GEOLOGIST: Leena Lothe

SURFACE ELEVATION: N/A

NOTES: Soil sample MMW-5D collected at 11'

COMMENTS: Sand heaving, split spoon after 19'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
TOPSOIL: About a foot of topsoil, top two inches asphalt	DPSS		NA				0.0	Casing and Concrete
SP: FINE TO MEDIUM SAND with trace gravel, dark yellowish brown (10YR 4/6), intermittent gray (10 YR 5/1) and red (10R 4/6) coloration, dry, no odor	SP	1	2.6	70%				
SW: FINE TO MEDIUM SAND with trace to some gravel, dry, no odor	SW	2	4.3					
			3.6					
			NA					
			4.0				5.0	
			5.8	70%				
			7.2					
			6.0					
SM: SILTY CLAYEY SAND mixture, with trace to some gravel, dry, no odor	SM	9.5	6.1	80%			10.0	
SW: FINE TO MEDIUM SAND with medium to large coarse gravel (10-12'), moist, no odor	SW	10.5	7.2					
			4.0					
			NA					
			4.4	75%				
			5.4				15.0	
SP: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SP	15.0	7.2					
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	19.0	7.8	60%			20.0	
			13.1					

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-5D

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: Central area of the northern fenceline

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-5D collected at 11'

DATE BEGAN: 08/24/04

PAGE 2 OF 3

DATE FINISHED: 08/24/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 12.0'

DEPTH OF BORING: 51'

TOP OF CASING ELEVATION: 711.75

SURFACE ELEVATION: N/A

COMMENTS: Sand heaving, split spoon after 19'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	P/D Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	10.6		70%			25.0	
		12.4						
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	13.7		90%			30.0	
- coarse gravel & gravel chips noted at 30.5'		15.6						
SW: FINE TO MEDIUM SAND with trace to some gravel, trace silt, wet, no odor	SW	4.5		60%			35.0	
		5.3						
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	29.3		90%			40.0	
		23.7						
SW: FINE TO MEDIUM SAND with trace to some gravel, trace silt, wet, no odor		35		100%			45.0	

Riser

Sand Pack

Screen

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-6D

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: NW area along northern fenceline

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-6D collected at 11-12'

DATE BEGAN: 08/23/04

PAGE 1 OF 3

DATE FINISHED: 08/23/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 14.0'

DEPTH OF BORING: 51'

TOP OF CASING ELEVATION: 712.68

SURFACE ELEVATION: N/A

COMMENTS: split spoon after 24'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
TOPSOIL: Top two inches asphalt followed by 4 inches base gravel	DP	0.0	NA				0.0	Casing and Concrete
SW: FINE TO MEDIUM SAND with trace to some fine to medium gravel, reddish brown (5 YR 4/3), dry, no odor	SW	1.0	0.7	75%				
			1.4					
			2.3					
- yellow (2.5 Y 7/6) coloration noted at 3.5', roots noted.			2.4					
			4.9					
			2.3	80%				
			2.5					
SP: FINE TO MEDIUM SAND with trace to some gravel, red (10 R 4/8) coloration noted at approx. 8', dry, no odor	SP	7.5	1.7					
		8.0	2.7					
SW: FINE TO MEDIUM SAND with trace to some gravel, light yellowish brown (2.5Y 6/3) moist, no odor	SW		3.6	75%				
			4.9					
CL: SANDY SILTY CLAY with trace to some mottled sand, red coloration (10R 4/8), moist, no odor	CL	11.5	3.1					
			5.6					
			7.3	70%				
			7.7					
			5.6					
			5.8	75%				
			8.1					
			6.1					
			NA					
SP: FINE CLAYEY SILTY SAND, with trace to some gravel, gray (2YR 5/0), wet, no odor	SP	21.0	3.5					
		21.5						
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	22.0	7.2	65%				



MMW-6D

Riser

Bentonite Grout

Water level on 8/23/04

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-6D

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: NW area along northern fenceline

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-6D collected at 11-12'

DATE BEGAN: 08/23/04

PAGE 2 OF 3

DATE FINISHED: 08/23/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 14.0'

DEPTH OF BORING: 51'

TOP OF CASING ELEVATION: 712.66

SURFACE ELEVATION: N/A

COMMENTS: split spoon after 24'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
SP: FINE SILTY SAND, with trace to some gravel, wet, no odor	SP	23.0	9.8					
		24.0	5.3					
	SP		6.2	70%			25.0	
			10.2					
			4.1	50%				
			9.6					
			10.8	50%				
SW: FINE TO MEDIUM SAND with trace to some silt, wet, no odor	SW	30.0	5.2				30.0	
		31.5	7.7	60%				
							35.0	
SP: FINE TO MEDIUM SAND with trace to some gravel, trace silt, wet, no odor	SP	37.25	14.7					
SW: FINE TO MEDIUM SAND with trace to some gravel, wet, no odor	SW	37.5	25.1	80%				
							40.0	
			17.4					
				60%			45.0	

Riser

Sand Pack

Screen

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-6D

PAGE 3 OF 3

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: NW area along northern fenceline

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-6D collected at 11-12'

DATE BEGAN: 08/23/04

DATE FINISHED: 08/23/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 14.0'

DEPTH OF BORING: 51'

TOP OF CASING ELEVATION: 712.68

SURFACE ELEVATION: N/A

COMMENTS: split spoon after 24'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
			10.2					
		48						
	CL		6.9					
			7.2	80%			50.0	
- End of the Boring at 51'								

MUNDELL & ASSOCIATES, INC.

BORING LOG

BORING NO: MMW-7S

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: NW corner well

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-7S collected at 15.5-16.5'

DATE BEGAN: 08/24/04

PAGE 1 OF 2

DATE FINISHED: 08/24/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 16.0'

DEPTH OF BORING: 26'

TOP OF CASING ELEVATION: 712.35

SURFACE ELEVATION: N/A

COMMENTS: split spoon after 24'

Lithologic Description	USCS Symbol	Stratum Depth (feet)	PID Headspace (ppm)	Rec. %	Sample Location	Sample ID	Depth (feet)	Water Level Information
ASPHALT: Top three inches asphalt followed by subbase SW: FINE TO MEDIUM SAND, potential fill with trace fine to medium gravel, light yellowish brown (2.5 Y 6/4), dry, no odor - color change beyond 2.0' to dark yellowish brown (10 YR 3/4)	ASPH	1.2					0.0	Casing and Concrete
		4.1		90%				
		3.7						
		6.7						
		5.6						
		4.8		80%			5.0	
		5.9						
		4.9						
		7.5						
		8.0						
		5.4						
		7.1		90%			10.0	
		8.8						
		5.4						
		4.9						
		7.1		90%				
		6.8						
		6.7					15.0	
		4.2						
		5.5		90%				
		7.3						
		7.4						
		21.0					20.0	
		21.5						
		22.0						

SW: PEBBLES with trace fine sand, gray (10 YR 6/1), dry, no odor

SP: FINE TO MEDIUM COARSE SAND, dark grayish brown (10 YR 4/2) moist, no odor

Water level on 8/24/04

MUNDELL & ASSOCIATES, INC.
BORING LOG

BORING NO: MMW-7S

CLIENT: AIMCO

PROJECT LOCATION: Indianapolis, Indiana

PROJECT NAME: Michigan Meadows

PROJECT NO: M01046

DRILLING CONTRACTOR: American Drilling Services

DRILLER: Bernie Byers

BORING LOCATION: NW corner well

FIELD GEOLOGIST: Leena Lothe

NOTES: Soil sample MMW-7S collected at 15.5-16.5'

DATE BEGAN: 08/24/04

PAGE 2 OF 2

DATE FINISHED: 08/24/04

DRILLING METHOD: HSA with 4' Geoprobe Sampler

DRILL EQUIP: CME 70

GW DEPTH (OBSERVED): 16.0'

DEPTH OF BORING: 26'

TOP OF CASING ELEVATION: 712.35

SURFACE ELEVATION: N/A

COMMENTS: split spoon after 24'

[illegible]



Boring/Well ID: MMW-13D-A

CLIENT: AMMH	FIELD SCIENTIST: Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/5/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION: 3' NW of MMW-8S	SURFACE ELEVATION: NS
SHEET 1 OF 4	

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-13D-A
0	CL		SILTY CLAY, yellowish brown, slightly moist (confirming lithology to original boring)	4.0					
1									
2									
3									
4			Blank Drill 4 ft to 20 ft						
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

—2" Dia. Borehole

REMARKS:

BGS = Below Ground Surface
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TPV = Total Photoionizable Vapors
NS = Not Surveyed



Boring/Well ID: MMW-13D-A

CLIENT: AMMH
 PROJECT LOCATION: Indianapolis, Indiana
 PROJECT NAME: Michigan Plaza
 PROJECT NUMBER: M01046
 DRILLING CONTRACTOR: SCS Environmental
 DRILLER: Andy Hermes
 BORING LOCATION: 3' NW of MMW-8S

FIELD SCIENTIST: Mark Breting
 DATE BEGAN: 3/5/2013
 DATE FINISHED: 3/11/2013
 DRILLING METHOD: Geoprobe
 DRILLING EQUIPMENT: 6620 DT
 GW DEPTH (OBSERVED): 20 ft
 SURFACE ELEVATION: NS

SHEET 2 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-13D-A
20	SP		fine SAND, gray (10 YR 6/1), loose, wet, non-plastic, with trace granules						
21				21.0					
22	SW		fine to coarse SAND, gray (10 YR 6/1), loose, wet, non-plastic			80			
23									
24				24.0					
25	SP		fine SAND, gray (10 YR 6/1), loose, wet, non-plastic, with trace granules		0.0				
26				25.6					
27			fine to coarse SAND and fine to coarse GRANULES, brown (10 YR 5/4), loose, wet, non-plastic, granules subangular to rounded			78			
28					0.0				
29					NR				
30						0			
31					NR				
32	SW-GW								
33					0.2				
34						100			
35					0.1				
36									
37					0.0				
38	CL		SILTY CLAY, dark gray (10 YR 4/1), medium stiff, slightly moist, slightly plastic, with some subangular granules	37.4		100			
39									
40	SW		fine to medium SAND, gray (10 YR 6/1), dense, wet, non-plastic	39.0	1.9				

2" Dia. Borehole

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Boring/Well ID: MMW-13D-A

CLIENT: AMMH	FIELD SCIENTIST: Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/5/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION: 3' NW of MMW-8S	SURFACE ELEVATION: NS

SHEET 3 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-13D-A
40	SP		fine SAND, gray (10 YR 6/1), dense, wet, non-plastic		0.0				
41									
42					100				
43	SW-F42		CLAYEY SAND and fine to coarse GRANULES, gray (10 YR 6/1), loose, very moist to wet, non-plastic, with small piece of clay mixed in at 43.2 ft	43.1	0.0				
44									
45					0.05				
46					50				
47	SW-GW				NR				
48			SAND and fine to coarse GRANULES, gray (10 YR 6/1), loose, very moist to wet, non-plastic	48.0					
49					0.0				
50	SW				100				
51			fine to medium SAND, gray (10 YR 6/1), loose, wet, non-plastic	51.0	2.0				
52			thin (0.01 ft) fragment of shale at 52 ft						
53					0.05				
54	SW-GW				100				
55					1.65				
56									
57					1.35	S	56-58' (DUP-2)		
58	CL				78				
59			fine to coarse SAND and fine to coarse GRANULES, gray (10YR 6/1), wet, loose, non-plastic	58.5 59.0	0.6	S	58-60'		
60			SANDY SILTY CLAY, very dark gray (10YR 3/1), slightly moist, medium stiff, slightly plastic						

2" Dia. Borehole

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Boring/Well ID: MMW-13D-A

CLIENT: AMMH	FIELD SCIENTIST: Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/5/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION: 3' NW of MMW-8S	SURFACE ELEVATION: NS
SHEET 4 OF 4	

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-13D-A
60	CL			61.0	0.3	80			2" Dia. Borehole
61									
62			End of boring at 61 ft						
63									
64									
65									
66									
67									
68									
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									

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Boring/Well ID: MMW-14D-A

CLIENT: AMMH	FIELD SCIENTIST: Gabriel Hebert/Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/6/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT Geoprobe
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION:	SURFACE ELEVATION: NS

SHEET 1 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-14D-A
0	CL		SILTY CLAY, dark brown, slightly moist (confirmed lithology to original soil boring)						H.A. to 4 ft
1									
2									
3									
4			Blank drill 4 ft to 20 ft						
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

2" Dia. Borehole

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H.A. = Hand Auger



Boring/Well ID: MMW-14D-A

CLIENT: AMMH	FIELD SCIENTIST: Gabriel Hebert/Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/6/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT Geoprobe
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION:	SURFACE ELEVATION: NS

SHEET 2 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-14D-A
20	SW		fine to coarse SAND, pale brown (10YR 6/3), wet, non-plastic	20.0	0.1	100			
21									
22									
23	CL		SILTY CLAY, gray (10YR 6/1), slightly moist, stiff	23.0	0.2	75			
24	SW		fine to coarse SAND, pale brown (10YR 6/3), wet, non-plastic	24.0					
25					0.55				
26									
27					0.65				
28	CL		GRANULES with SAND, pale brown (10YR 6/3), wet, non-plastic			90			
29					1.3				
30				30.0	1.05				
31									
32	CL		SILTY CLAY, gray (10YR 6/1), moist, stiff		3.9	75			
33									
34					3.25				
35				36.0					
36			SAND and GRANULES, light grayish brown (10YR 6/2), wet, non-plastic	37.0	2.2	100			
37									
38									
39					5.4				
40									

2" Dia. Borehole

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Boring/Well ID: MMW-14D-A

CLIENT: AMMH	FIELD SCIENTIST: Gabriel Hebert/Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/6/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT Geoprobe
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION:	SURFACE ELEVATION: NS

SHEET 3 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-14D-A
40									
41					15.3				
42			fine to coarse GRANULES with some fine to coarse SAND, gray (10YR 6/1), wet, non-plastic	42.0		75			
43					9.95				
44			fine to coarse SAND, gray (10YR 6/1), wet, with some fine to coarse granules, non-plastic	44.0					
45					18.4		S	44-46'	
46						100			
47					9.25				
48	SW								
49					5.5				
50						100			2" Dia. Borehole
51					6.2		S	50-52'	
52									
53	CL		SILTY CLAY, gray (10YR 5/1), slightly moist, stiff	52.4					
54	SW-GW		fine to coarse SAND and fine to coarse GRANULES, gray (10YR 6/1), wet, loose, non-plastic	53.2	2.4				
55						80			
56	SP		fine SAND, light gray (10YR 7/1), wet, dense, non-plastic	55.1	1.85				
57	SW		fine to medium SAND, gray (10YR 6/1), wet, medium dense, non-plastic	56.0					
58			fine to coarse SAND and fine to coarse GRANULES, gray (10YR 6/1), wet, loose	56.5					
59					0.2				
60						58			
					0.65				

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Boring/Well ID: MMW-14D-A

CLIENT: AMMH	FIELD SCIENTIST: Gabriel Hebert/Mark Breting
PROJECT LOCATION: Indianapolis, Indiana	DATE BEGAN: 3/6/2013
PROJECT NAME: Michigan Plaza	DATE FINISHED: 3/11/2013
PROJECT NUMBER: M01046	DRILLING METHOD: Geoprobe
DRILLING CONTRACTOR: SCS Environmental	DRILLING EQUIPMENT: 6620 DT Geoprobe
DRILLER: Andy Hermes	GW DEPTH (OBSERVED): 20 ft
BORING LOCATION:	SURFACE ELEVATION: NS

SHEET 4 OF 4

Depth BGS (ft)	USCS Symbol	USCS Graphic	Lithologic Description	Stratum Depth (ft)	TPV (ppm)	Recovery %	Sample Location	Comments	MMW-14D-A
60									
61					1.05				
62						100			
63					0.75				
64				64.0					
65	SP		fine SAND, gray (10YR 6/1), wet, very dense, non-plastic		0.6	100			
66									
67				67.0	0.45				
68			Refusal at 67 ft (driller notes refusal occurred within sand)						
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									

2" Dia. Borehole

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